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Spring 2-1-2019

GEO 420.01: Hydrogeology

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SYLLABUS – GEO 420 '
HYDROGEOLOGY '
Spring 2019 '

Schedule: T, Th 8:00-9:50, CCHB 304 !
Instructor: W. Payton Gardner, CCHB 353 !
Office hours: T: 10:00-11:00 or by appt. !

Course Description: Fundamental physics of groundwater flow and applications in hydrogeology and earth sciences. Topics include: Darcy's law, groundwater flow equation, storage, regional groundwater flow, hydrogeologic investigation, aquifer characterization and evaluation. This course will help students in a variety of earth and environmental sciences develop the skills to understand the movement and occurrence of groundwater and its role in the hydrologic system. The focus is on developing the skills and understanding needed to quantitatively analyze applied hydrogeologic problems.

Learning Outcomes:

- Students will be able describe the fundamental subsurface properties which control the occurrence, storage and movement of groundwater.
- Students will be able to manipulate Darcy's law to calculate groundwater discharge and velocity.
- Students will be able to derive the groundwater flow equation for a variety of aquifer types and configurations.
- Student will be able to apply Darcy's law and solutions of the groundwater flow equations to quantitatively solve applied hydrogeologic problems including: aquifer characterization, groundwater storage and supply evaluation, contaminant migration.
- Students will be able to quantitatively calculate the interaction of groundwater with surface systems.
- Students will understand the role of groundwater in Montana water supply and water rights applications.

Grading: 100-90 A, 89-80 B, 79-70 C, 69-60 D, 59 or less F

Weighting:

Labs:	10%
Assignments:	40%
Midterms:	20%
Final Project:	15%
Final Exam:	15%

Students will be evaluated on their ability to master the topics covered, with specific focus on the stated learning outcomes, and their participation in class. The ability of students to learn and apply the concepts presented will be evaluated by testing as well as in assignments. In class participation, will be quantified by in class lab experiments and occasional quizzes. This is a fast-

paced, quantitative class, each day of lecture is very important. Don't miss class, and stay up on your reading. Homework assignments are work intensive. **Don't** expect to be able to finish the homework the night before its due - start working on it as soon as you get it. Homework should be clean, clear and edited. It will be turned in by 5:00pm the day it is due.

Final Project:

The final project will be a Montana water rights application which utilizes the skills gained during class. The objective is for students to get experience amalgamating different hydrogeologic datasets and writing an applied water resources evaluation.

Course website:

Please check the course website (Moodle) regularly, especially before class, for announcements, notes, readings, assignments, and schedule updates.

Email:

Feel free to communicate with me by email, but please ask homework questions in class (others likely have similar questions).

Late Policy:

Assignments handed in late will have 5% of total points deducted per day (starting at the time when the assignment is due). No credit allowed for assignments handed in > 1 week after due date or after answer key / grading rubric posted, whichever comes first.

Student Conduct Code:

The Student Conduct Code at the University of Montana embodies and promotes honesty, integrity, accountability, rights, and responsibilities associated with constructive citizenship in our academic community. This Code describes expected standards of behavior for all students, including academic conduct and general conduct, and it outlines students' rights, responsibilities, and the campus processes for adjudicating alleged violations. [Full student conduct code. http://www.umt.edu/vpsa/policies/student_conduct.php](http://www.umt.edu/vpsa/policies/student_conduct.php)

Course Withdrawal:

Students may use Cyberbear to drop courses through the first 15 instructional days of the semester. Beginning the 16th instructional day of the semester through the 45th instructional day, students use paper forms to drop, add and make changes of section, grading option or credit. GEO391 may not be taken as credit/no-credit.

Disability Modifications:

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and [Disability Services for Students](#). If you think you may have a disability adversely affecting your academic performance, and you have not already registered with Disability Services, please contact Disability Services in Lommasson Center 154 or call 406.243.2243. We will work with you and Disability Services to provide an appropriate modification.

Schedule of Topics:

Note: The schedule below represents a loose plan of the best intentions. I'm sure the real course of events will deviate as we move along.

Week	Topic	Reading/Deadlines
1 1/10,15	Introduction to groundwater, Hydrologic cycle	1,2
2 1/17,22	Basic fluid mechanics, fluid potential, Darcy's law.	Bernouli chapter, Hubbert 1940, 3
3 1/24,29	Hydraulic properties of geological media: Porosity, permeability, heterogeneity and anisotropy.	3, HW1 due 1/24
4 1/31,2/5	Groundwater flow theory: Saturation, capillarity, relative permeability.	6.1,6.2
5 2/7,12	Storage. Geology and Groundwater. Aquifers and Aquitards.	4 HW2 due 2/7
6 2/14,19	Groundwater flow theory: groundwater flow equation, boundary conditions.	5 Exam I – 2/19
7 2/21,26	Groundwater flow theory: flow nets. boundary value problems.	5
8 2/28,3/5	Groundwater flow theory: unsaturated flow, fracture flow	6.3-6.6 HW3 due 3/13
9 3/7,12	Groundwater flow theory: variable density flow – seawater intrusion	8.7
10 3/14,21	Regional Groundwater flow: topography and geology recharge, discharge. Groundwater Regions of MT.	8 HW4 due 3 /21
11 3/25,29	Spring break	
12 4/2,4	Surface water, groundwater interactions.	8 ,10 Exam II 4/4
13 4/9,11	Groundwater Investigations: Wells and drilling, flow to wells, response of confined aquifers	7,9
14 4/16,18	Groundwater Investigations: Response of unconfined aquifers to pumping, slug tests	11, 12 HW5 due 4/16
15 4/23,25	Superposition	13 Final project due 4/26
	Final Exam – Monday April 29th - 8:00-10:00	